Section 5 -- Resource Based Evaluation of the Recovery Strategy

The intent of the Caloosahatchee MFL is to protect wild celery, *Vallisneria americana*, in a 640 acre area located between 24 and 30 km upstream of Shell Point, from significant harm. This area encompasses about 60% of the total estuarine area that could potentially support *V. americana*. Additional water, supplied by CERP project components, should protect *V. americana* from significant harm. Significant harm was defined as loss of *V. americana* habitat function for two consecutive years. In this section, the recovery strategy is evaluated using a recently developed numerical model that estimates density of *V. americana*.

The density of *V. americana* was estimated on a daily time step based on responses to light, salinity and temperature at two sites (1 and 2, **Figure 4-2**) in the upper estuary (**Appendix H**). The model did not simulate sexual reproduction or seed germination. Water quality parameters and *V. americana* density have been monitored at these sites since 1998. The model was calibrated based on measured *V. americana* densities, water temperature, and transparency for the period 1998-2001. Daily salinity input was estimated from flows using the Caloosahatchee Hydrodynamic model (**Appendix F**). Daily incident PAR was obtained from a continuous recording station in Estero Bay.

The recovery strategy was evaluated by comparing the simulated performance of *V. americana*, monitoring Sites 1 and 2 (**Figure 4-2**) under the hydrologic conditions of the '1995 base' scenario (present conditions) and the '2020 with Restudy' (CERP components in place). Long–term (31-year) simulations were computed for *V. americana* using salinity regimes predicted by a regression equation derived from the 3-D hydrodynamic model (**Appendix F**) for both the '1995 base' scenario and the '2020 with Restudy' scenario. Input water temperature, transparency, and PAR were determined using averaged annual data sets (determined from the calibration period). Therefore, salinity was the only dynamic variable in these simulations and the remaining inputs were maintained as "average conditions" throughout each annual cycle.

The input salinity data for the two scenarios at the two monitoring sites are shown in **Figures 5-1 and 5-2** and summarized in **Table 5-1**. When compared to the '1995 Base' case peak salinities are much reduced in the '2020 with Restudy' scenario. The 30-day
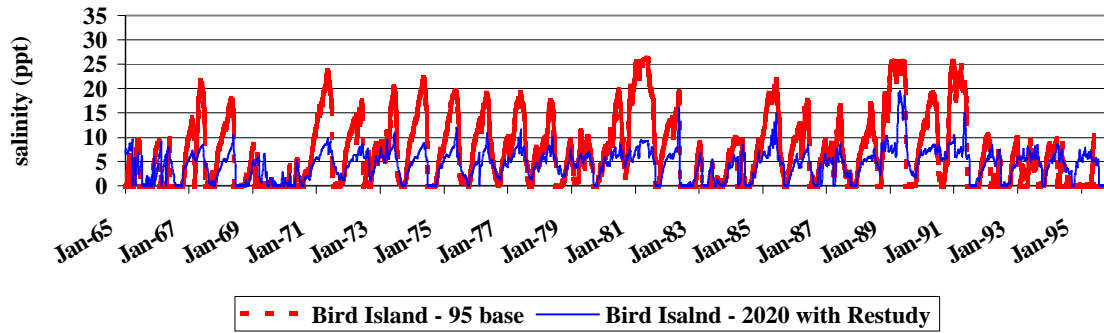
Figure 5-1. Predicted daily average salinity at *Vallisneria* Monitoring Site 1, Bird Island.
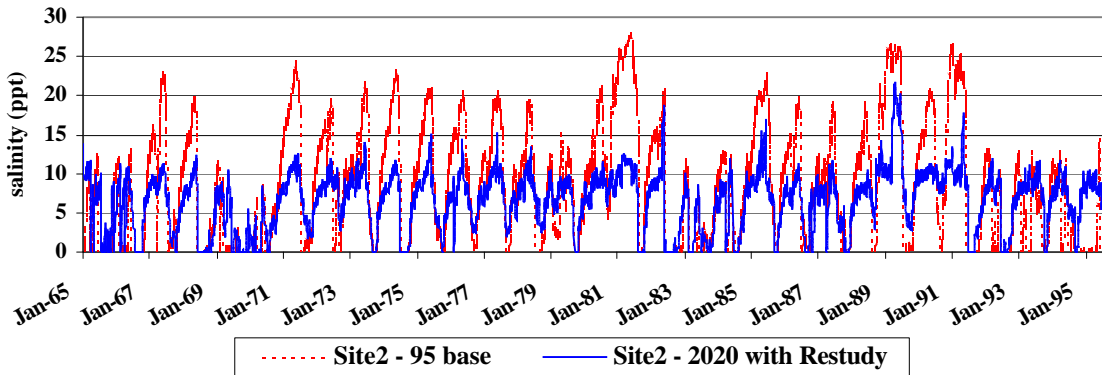

Figure 5.2. Predicted daily average salinity at *Vallisneria* Monitoring Site 2.

Table 5-1. Frequency analysis of predicted salinity at Site 1, Bird Island and Site 2. Percentages represent the fraction of days in the 31-year period of record when the daily average or moving average salinity was in a particular range.

	Site 1, Bird Island				Site 2			
	95 base		2020 with Restudy		95 base		2020 with Restudy	
salinity (ppt)	daily (%)	30-day moving average (%)	daily (%)	30-day moving average (%)	daily (%)	30-day moving average (%)	daily (%)	30-day moving average (%)
0~5	49	49	53	53	42	41	33	33
5~10	23	24	45	46	17	19	53	54
10~13	7	8	1	1	14	13	12	11
13~15	3	4	0	0	5	6	1	0
15~20	11	10	1	1	13	12	1	1
20~25	4	4	0	0	6	6	0	0
25~30	2	1	0	0	3	2	0	0

moving average salinity is below 10 $^o/_{oo}$ 98 % of the time at Site 1 and 87 % of the time at Site 2. At the most upstream Site 1, this criterion was exceeded in 23 of 31 years in the '1995 Base' and in only 5 of 31 years for the '2020 with Restudy' (**Figure 5-3**). Further

downstream at Site 2, the 30-day moving average salinity exceeded 10 $^o/_{oo}$ in 30 of 31 years for the '1995 Base' and in 17 of 31 years for the '2020 with Restudy' (**Figure 5-4**).
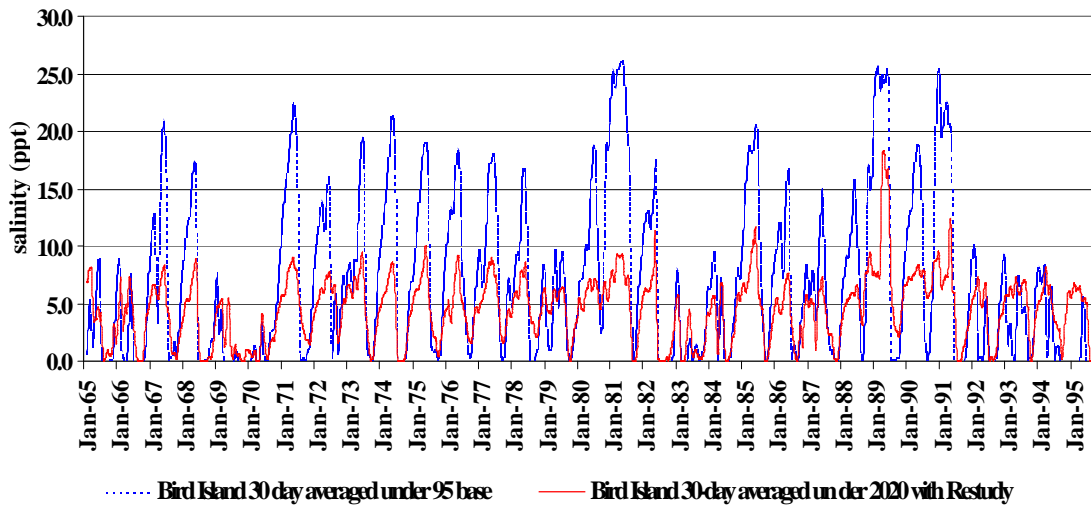

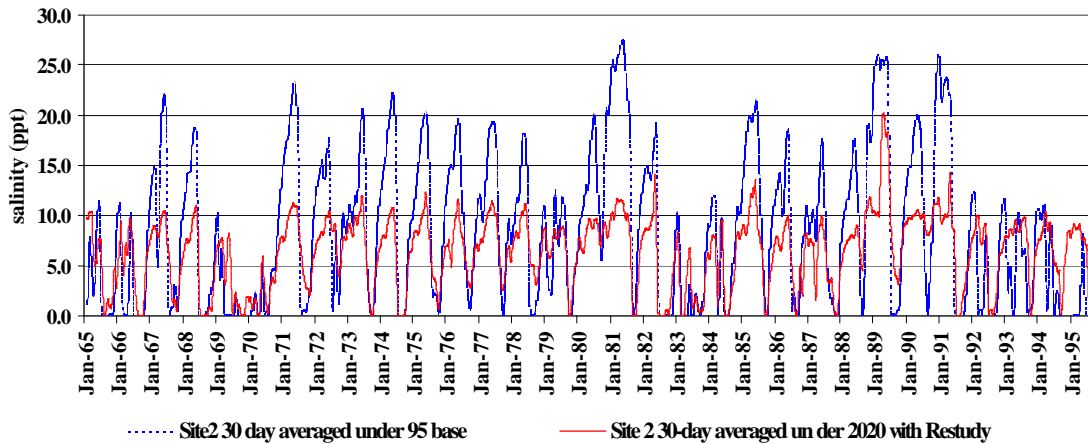Figure 5-3. 30-day moving averaged salinity at Bird Island

Figure 5-4. 30-day moving average salinity at Site 2.

The numerical simulations of *V. americana* shoot densities (Appendix 8) using the '2020 with Restudy' project flow conditions show more favorable densities than the 95 base case at both Station 1 and Station 2 (**Figures 5-5** and **5-6**). Specifically, there is a 68% increase in total number of shoots produced for the 31 year period modeled at Station 1 and 51 % increase at Station 2 in the '2020 with Restudy' scenario compared to the 95 base case. For blade density, there is a 74% increase at Station 1 and 23% at Station 2 in the '2020 with Restudy' scenario compared to the '95 base case.'
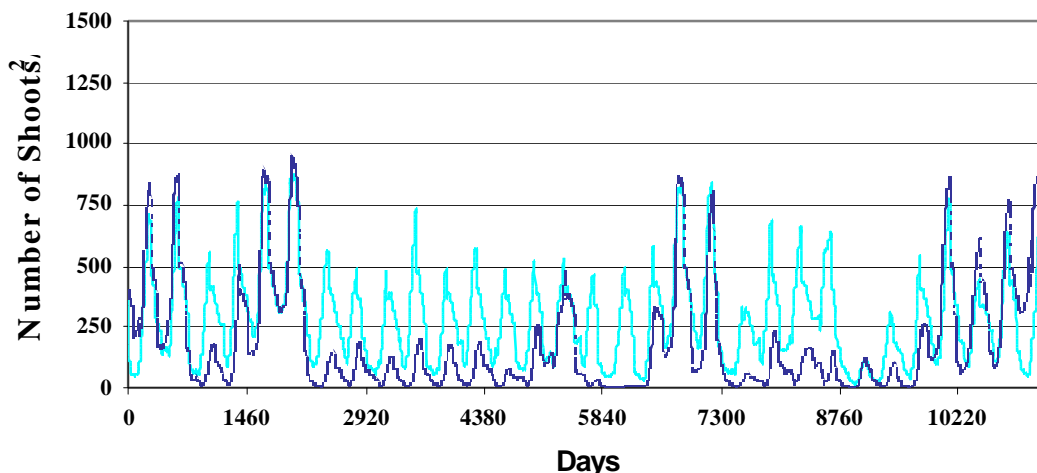
Figure 5-5. Simulated performance of *Vallisneria americana* at Site 1 under the '1995 Base' and '2020 with Restudy' scenarios.
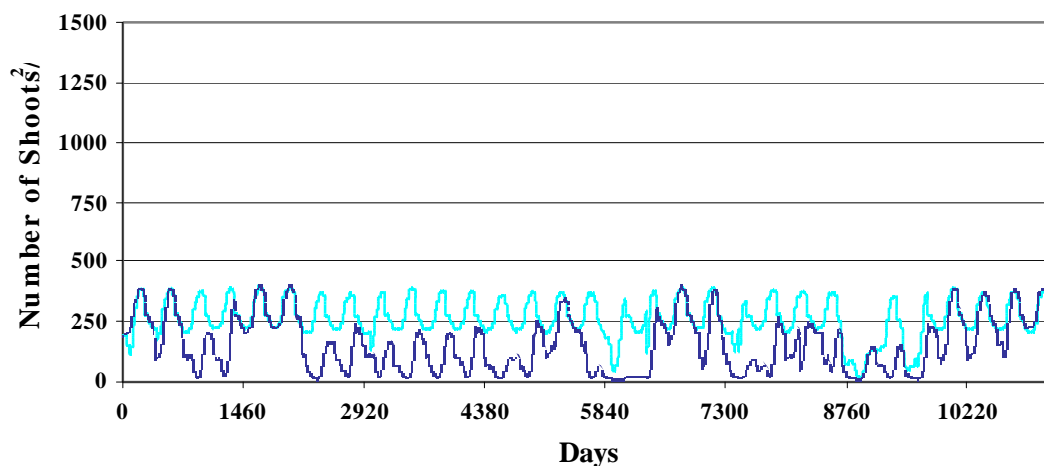

Figure 5-6. Simulated performance of *Vallisneria americana* at Site 2 under the '1995 Base' and '2020 with Restudy' scenarios.

Following the original technical documentation, loss of habitat function for a *V. americana* grass bed was assumed to occur at a density of 20 shoots/m^2 or less. Under the '1995 Base' loss of habitat function occurred in 9 of 31 years at Site 1, with significant harm (loss for two consecutive years) occurring 6 times. Further downstream, at Site 2 loss occurred 17 times in 31 years with significant harm occurring 12 times. By contrast, under the '2020 with Restudy' case, shoot densities fell below 20/m^2 only once at each site in 31 years.

Taken together, the simulated salinity and *V. americana* shoot density data for the two monitoring sites indicate that the MFL is not presently being met. Based on the analysis of salinity conditions downstream at Ft. Myers, this result is not surprising. On the other

hand, the results for *V. americana* shoot densities indicate that the '2020 with Restudy' scenario may afford an acceptable level of resource protection at these two sites. Since Site two is located at 26 km upstream of Shell Point, the results suggest that the '2020 with Restudy' may provide resource protection over about two-thirds of the area set aside for protection of *V. americana* (24 km – 30 km).   While exceedances of the 30-day average MFL salinity criterion appear to occur under the '2020 with Restudy' at both Site 1 and Site 2, these exceedances are of lower magnitude and shorter duration than those in the '1995 Base' (**Figure 5-3** and **5-4**).   These results further indicate that 10 ppt is an effective criterion for protecting the *V. americana* community from significant harm.